Molybdenum - pearl in sludge

The name molybdenum dates back to ancient times. The Greekdoctor and pharmacist Dioscurides gave the Greek name “molybdae” to a number of substances that lose color like lead. This term is also found in the famous “Historia Naturalis,” which the Roman scholar Pliny the Elder published in 77 B.C.

It took another 1,700 years before Carl Wilhelm Scheele was able to isolate a white oxide (molybdenum trioxide). He subjected molybdenum glance (molybdenite, molybdenum disulfide), which had until then often been mistaken for graphite, to repeated doses of diluted nitric acid. He then distilled off the acid and named this substance “molybdic ocher” (terra molybdaenae). Scheele also observed the oxide’s characteristic blue color when under the influence of reducing agents and its acidic nature. In experimental work shortly thereafter he obtained a potassium salt in crystalline form from this oxide.

In 1785, B. Pelletier succeeded in obtaining a molybdic acid by thoroughly roasting molybdenum glance. In addition, he established conclusively the sulfide nature of the mineral. He was also the first to attempt to produce metallic molybdenum and some alloys of the metal. It was P.J. Hjelm, however, who, a short time later, first succeeded in obtaining the metal.
At the suggestion of his friend Scheele, between 1788 and 1792 Hjelm repeatedly reduced the molybdic acid with carbon and ultimately produced the metal in its pure state. The basis of modern molybdenum chemistry was created by Jöns Jacob Berzelius, who in 1816, managed to obtain the metal by means of hydrogen reduction for the first time.

The most important molybdenum minerals are the above mentioned molybdenum glance, powellite (calcium molybdate) and wulfenite, which is also called yellow lead ore (lead molybdate). Besides molybdenum glance, another mineral deposit is ferrimolybdite, a hydrated ferromolybdate, as the name implies.

Unlike tungsten, molybdenum deposits that would be useful for mining occur infrequently. One of the most famous molybdenum sources is the mine of American Metal Climax, better known as Climax, in Colorado in the United States. According to recent estimates, it is thought to contain 300 million tons of molybdenum. Canada, Chile and China are also important molybdenum suppliers. European deposits worth mentioning are near Stavanger in Norway, and in Sweden. In Central Europe, beds of molybdenum (molybdenum glance) are found mainly in the Erz Mountains. There are also smaller wulfenite deposits in Upper Bavaria, Germany and in Kärnten, Austria.

The heavy metal molybdenum, whose color is similar to tin, has a density of 10.22, and is much lighte than tungsten. Like tungsten molybdenum has a high melting point (2,620° C) and boiling point (5,560° C).
According to the Mohs’ scale, its hardness is 5.5, which is much lower than that of tungsten. Chemically it is also somewhat more reactive than tungsten. When intensively heated, molybdenum is oxidized in air to trioxide, which sublimates at temperatures above 800° C. Nitric acid, concentrated sulfuric acid and nitrohydrochloric acid corrode the metal, as do halogens and solutions of heavy metal salts.

Most molybdenum compounds are only very slightly toxic. But as a constituent of the enzymes nitrogenase and nitrate reductace, which play a major role in nitrogen fixation by blue-green algae and rhizobium bacteria, molybdenum metal serves as an essential trace element.

Nitrogen fixation is invaluable for agriculture because without nitrogen intake, the production of vegetable proteins – and thus also the development of higher living organisms on earth – would be impossible.

Important as a trace element

Molybdenum is also an important trace element for human beings. As a part of certain enzymes, such as xanthine oxidase and sulfite oxidase, molybdenum plays a major role in metabolism. Xanthine oxidase has the task of converting the purines that form during food metabolism into uric acid so that they can be eliminated from the body via the kidneys.

Interestingly, animal tests show that molybdenum has an inhibitive effect on certain kinds of cancer, including breast cancer and cancer of the esophagus and the anterior stomach. Other studies indicate that molybdenum promotes fluoride intake in bones and teeth enamel, which helps prevent bone decomposition and tooth decay.

For this reason, a certain amount of molybdenum is important in a well-balanced diet. The Academy of Sciences in the United States recommends a daily dose of 0.15 to 0.5 milligrams. Those who eat food rich in molybdenum regularly – mainly leguminous plants and cereal products – need not worry about molybdenum deficiency.

One of the H.C. Starck's original activities

Unlike the important alloying metals tungsten, cobalt and nickel, with which Gebr. Borchers had been involved even before theturn of the century, molybdenum is among the original activities of Hermann C. Starck's company.
Molybdenum was mentioned as a substitute for tungsten in the founding papers of the "Elektrochemischen Werke Bitterfeld" in Laufenburg, which was later to become the Ampere-Gesellschaft and H.C. Starck plant.

It was first produced in amounts comparable to those of the two alloys ferrotungsten and ferrochromium. A roasting furnace to desulfurize the typical sulfidic molybdenum ores went on stream at the plant on the Upper Rhine in 1916.

The "Chemische Fabrik Altherzberg" also took early steps to try to produce suitable molybdenum intermediates for the ferroproduction. Among these products were calcium molybdate from the molybdic ocher of the Alp region or from the molybdenum deposits of the nearby Erz Mountains. As far as can be determined from company papers, these ferroalloys were melted in small, onephase 500 kilowatt electric arc furnaces in Laufenburg.

In the wartime years of 1917 and 1918, 10 to 15 tons of ferromolybdate were produced in Laufenburg every month. However, at the end of World War I this production came to a standstill because demand dropped sharply and tungsten, more popular in those days, was once again available.

Laufenburg was not the only plant to be affected by this trend. The interruption took place worldwide, which meant that the Climax mine in Colorado was temporarily closed.

International activities in the molybdenum sector resumed in the 1920s. In the meantime experts recognized that the metal was not just a “stopgap” when there was a shortage of tungsten, but that it had its own advantages as an alloying material. Toughness, durability and corrosion resistance are among molybdenum’s most prominent characteristics.